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Docket No. 32011-164584
Date: June 26, 2000

NEW PATENT APPLICATION TRANSMITTAL RULE §1.53(b)

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Transmitted herewith for filing under 37 C.F.R. §1.53(b) is a nonprovisional patent application:

For (Title): DATA COMMUNICATION SYSTEM

By (Inventors): Eiichiro KAWAKAMI, Atsuhiko SUGITANI, Satoru SHIMIZU

- 13 pages of Specification/Claims 1-13/Abstract are attached.
 Formal drawings (Fig. 1-3; 3 sheets) is attached.
 A Declaration and Power of Attorney is filed herewith.
 An assignment of the invention to, is filed herewith, along with form PTO-1595 and a check for \$40.00.
 An Information Disclosure Statement is filed herewith, along with form PTO-1449, and 2 reference.
 A Statement to establish small entity status under 37 C.F.R. §§1.9 and 1.27 is filed herewith.
 A Preliminary Amendment is filed herewith.
 Please amend the specification by inserting before the first line the sentence --This nonprovisional application claims the benefit of U.S. Provisional Application No. ___, filed _____.
 Priority of foreign application No. 181098/1999 filed June 28, 1999 in JAPAN is claimed (35 U.S.C. §119).
 A certified copy of the above corresponding foreign application is filed herewith.

The filing fee is calculated below and includes claim status after entry of any Preliminary Amendment noted above:

FOR:	NO. FILED	NO. EXTRA
BASIC FEE		
TOTAL CLAIMS	13 - 20	= 0
INDEP CLAIMS	1 - 3	= 0
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIMS		

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RATE	FEES
	\$ 345
x 9 =	\$
x 39 =	\$
+130 =	\$
TOTAL	\$

LARGE ENTITY

OR	RATE	FEES
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OR	x 18	\$
OR	x 78	\$
OR	+260	\$
OR	TOTAL	\$ 690

- A check in the amount of **\$690.00** is attached hereto. Except as otherwise noted herein, the Commissioner is hereby authorized to charge any other fees that may be required to complete this filing, or to credit any overpayment, to Deposit Account No. 22-0261.
- This application is entitled to small entity status. DO NOT charge large entity fees to our Deposit Account.

Respectfully submitted,

James R. Burdett
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DATA COMMUNICATION SYSTEM

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a data communication system that is provided with one main station and one or a plurality of substations, and more particularly to a data communication system for broadcast communications from the main station to the substations.

Description of Related Art

Before now, data communication systems having one main station and one or a plurality of substations were known. These data communication systems are systems for broadcast communication from a main station to the substations. Broadcast communication is communication wherein data addressed to one or a plurality of substations are transmitted from one main station. With broadcast communication, the same data can be transmitted to one or a plurality of substations substantially at the same time. In the case of effecting broadcast communication, the main station queries the substations as to whether the data were received normally once a prescribed quantity of data is transmitted. This query operation is generally called polling. Polling methods are disclosed in "Information communications protocol", Tadao Saito and Mitsuhiro Ishizaka, pp. 73, Ohm Co., for example.

In polling by a conventional data communication system, the main station queries each substation individually as to

whether the data were received normally. For this reason, the main station must perform the query operation for the same times as the number of substation that received the data. Consequently, when a large number of substations received data, the query operation is performed many times and the data communication becomes inefficient.

SUMMARY OF THE INVENTION

It is an object of the present invention to improve data communication efficiency by simplifying polling in broadcast communication.

In order to achieve this object, the data communication system relating to the present invention comprises the following: means for transmitting data addressed to all substations provided in the main station; means for receiving data provided in the substations; means for transmitting a message addressed to all substations after data are transmitted, to inquire whether reception was normal, provided in the main station; and means for transmitting a response message to the query message, only when said data could not be received normally, provided in the substations.

The time for confirming whether transmission was normal can be shortened by the main station transmitting data addressed to all substations, and the substations transmitting a response message only in the event of abnormal reception.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention are explained with reference to the following appended drawings.

Figure 1 is a block diagram showing an example constitution of a communication system relating to the present invention; and

Figures 2 and 3 show timing charts for explaining the data communication procedure relating to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiments of the present invention are explained below using the drawings. In the drawings, the sizes, forms, and positional relationships among the structural elements are merely to aid in the understanding of the present invention. Moreover, the numerical conditions in the following explanation are merely a simple illustration.

Figure 1 is a block diagram showing the constitution of a communications system relating to the present embodiment.

As shown in Figure 1, this communication system comprises one main station 101 and a plurality of substations 102, 103, 104 that are connected by a common transmission line 105.

The main station 101 transmits a prescribed quantity of data on the transmission line 105. The main station 101 then transmits a message, for inquiring whether the

transmitted data were received normally, on the transmission line 105. Then, in the case where a response message is received from the transmission line 105 within a prescribed period of time from the transmission of this query message, the previously transmitted data are transmitted another time. On the other hand, when a response message is not received within the prescribed time period, the next data are transmitted.

The substations 102 - 104 receive data from the transmission line 105 and then, after receiving the data, receive the query message from the transmission line 105. After receiving data, the substations 102 - 104 determine whether data were received normally or abnormally. In the case of abnormally received data, the substations 102 - 104 transmit a response message on the transmission line 105 when the query message is received from the transmission line 105. In the case of normally received data, however, response messages are not sent.

Next, the basic communication procedures of the data communication system shown in Figure 1 are explained.

Figure 2 is a timing chart for explaining the communication procedures.

The main station 101 effects message transmission and reception synchronized with the period T slot clock. Consequently, times t_1 - t_5 discussed below are given by the leading edge or trailing edge of the slot clock.

At the time t_1 , the main station 101 transmits the first transmission data D1. This transmission data D1 reaches each substation 102 - 104 via the transmission line 105. The substations 102 - 104 thereby receive the same data D1 at essentially the same time.

At time t_2 , the main station 101 transmits the query message PA1 regarding the transmission data D1. This query message PA1 is addressed to all substations 102 - 104. The query message PA1 reaches each of the substations 102 - 104 via the transmission line 105.

The main station 101 effects carrier sensing during the time from the transmission of the query message PA1 until the next transmission time t_3 . As discussed above, the substations 102 - 104 return a response message or carrier in the case where data reception was abnormal, but do not return a response message when data reception was normal. In the example in Figure 2, the main station 101 determines that the transmission data were received normally by all substations 102 - 104 because the response message was not received by time t_3 .

Consequently, the main station 101 transmits the next transmission data D2 on transmission line 105 at time t_3 . The transmission data D2 reach all substations 102 - 104 via the transmission line 105.

At time t_4 , main station 101 transmits the query message PA2 for the transmission data D2 on the transmission line 105. The query message PA2 reaches each

of the substations 102 - 104 via the transmission line 105.

The main station 101 effects carrier sensing during the time from the transmission of the query message PA2 until the next transmission time t5.

In the example in Figure 2, the main station 101 detects response messages N1, N2, or carriers, generated from substations 103, 104. With the detection thereof, the main station 101 confirms that reception errors occurred in at least one substation.

Consequently, the main station 101 sends the transmission data D2 once again at time t5. The transmission data D2 are received by substations 102 - 104 via the transmission line 105. The substation 102 received the data D2 normally at the previous transmission. Consequently, the substation 102 scraps this transmission data D2. Meanwhile, the substations 103 and 104 take up the transmission data D2 because they were unable to receive the data D2 normally at the previous transmission.

In this data communication system, as explained above, the main station 101 is constituted so as to transmit query messages addressed to all substations 102 - 104, and the substations 102 - 104 are constituted so as to send response messages only when reception errors occur. Consequently, the time required to confirm reception becomes short even when there is a large number of substations. Consequently, the efficiency of data communication can be improved.

The procedures for when the data communication system shown in Figure 1 is interrupted during communication are explained next.

Figure 3 is a timing chart for explaining the communication procedures. Figure 3 shows an example of the case where the same data are resent twice by the main station 101.

The main station 101 sends the transmission data D3 at time t6. The transmission data D3 reach the substations 102 - 104 via the transmission line 105. The substations 102 - 104 thereby receive the same data D3 at essentially the same time.

The main station 101 transmits the query message PA3 for the transmission data D3 at time t7. This query message PA3 is addressed to all substations 102 - 104. The query message PA3 reaches each substation 102 - 104 via the transmission line 105.

The main station 101 effects carrier sensing during the time from the transmission of the query message PA3 until the next transmission time t8. At this time, in the example in Figure 3, the main station 101 detects a response message N3 generated by substation 103. With the detection thereof, the main station 101 determines that a reception error occurred in at least one substation.

Consequently, the main station 101 sends the transmission data D3 once more at time t8. This transmission data D3 is received by the substations 102 -

104 via the transmission line 105. Because the substations 102 and 103 received the data D3 normally at the previous transmission, they scrap this transmission data D3.

Meanwhile, the substation 104 takes up the received data D3 because the substation 104 was unable to receive the data D3 normally at the previous transmission.

At time t9, the main station 101 transmits the query message PA4 regarding the transmission data D3. This query message PA4 is addressed to all substations 102 - 104. The query message PA4 reaches each substation 102 - 104 via the transmission line 105.

The main station 101 effects carrier sensing until the next transmission time t10. At this time, in the example in Figure 3, the main station 101 detects a response message N4 generated by the substation 103.

The main station 101 sends the transmission data D3 a third time at time t10. The transmission data D3 is received by the substations 102 - 104 via the transmission line 105. Because the substations 102 and 103 received the data D3 normally at the previous transmission, they scrap this transmission data D3. Meanwhile, the substation 104 takes up the received data D3 because the substation 104 was unable to receive the data D3 normally at the previous transmission.

At time t11, the main station 101 transmits the query message PA5 regarding the transmission data D3. This query message PA5 is addressed to all substations 102 - 104. The

query message PA5 reaches each substation 102 - 104 via the transmission line 105.

The main station 101 effects carrier sensing until the next transmission time t_{12} . At this time, in the example in Figure 3, the main station 101 detects a response message N5 generated by the substation 103. However, because the same data D3 have now been resent twice, the main station 101 terminates transmission of the data D3 and transmits the next data D4 at time t_{12} . The main station 101 then transmits a query message PA6 regarding the transmission data D4 at time t_{13} .

As explained above, in this data communication system, re-transmission is terminated when the same data have been resent twice, even if one or more substations which has been unable to receive the data normally are exist. Consequently, it does not become impossible to update all the substations, even if some substations can not received the data normally.

In the embodiment discussed above, an example with a plurality of substations was used, but this can be applied to a data communication system with only one substation.

In the embodiment discussed above, data are resent a maximum of two times, but this maximum may be one time, or three or more times. Furthermore, this maximum can be freely changed by the data communication system administrator depending on conditions.

What is claimed is:

1. A data communication system comprising:
means for transmitting data addressed to all
substations, provided in the main station;
means for receiving said data, provided in the
substations;
means for transmitting a message addressed to all
substations after said data are transmitted, to inquire
whether reception was normal, provided in said main
station; and
means for transmitting a response message to said
query message, only when said data could not be received
normally, provided in said substations.

2. The data communication system, according to Claim
1, wherein said main station receives said response message
within a prescribed period of time after the transmission
of said query message.

3. The data communication system, according to Claim
2, wherein said prescribed period of time is the period
until the time to start the next transmission of said data.

4. The data communication system, according to Claim
2, wherein said main station determines that all of said
substations were able to receive said data normally, when
said main station does not receive said response message
within said prescribed period of time.

5. The data communication system, according to Claim
4, wherein said main station effects the next data

transmission when said response message is not received within said prescribed period of time.

6. The data communication system, according to Claim 2, wherein said main station determines that any of said substations was unable to receive said data normally, when said main station receives said response message within said prescribed period of time.

7. The data communication system, according to Claim 6, wherein said main station re-transmits said data when said response message is received within said prescribed period of time.

8. The data communication system, according to Claim 7, wherein said main station terminates the transmission of said data and effects the transmission of next data when said response message is received after the same data have been transmitted a prescribed number of times.

9. The data communication system, according to Claim 8, wherein said main station comprises means for changing said prescribed number of times.

10. The data communication system, according to Claim 1, wherein said substations, when said normally received data are received once more, scrap these data.

11. The data communication system, according to Claim 1, wherein said substations, when said data that could not be normally received are received once more, take up these data.

12. The data communication system, according to Claim 1, wherein there is one of said main stations and one or a plurality of said substations.

13. The data communication system, according to Claim 1, wherein said main station and said plurality of substations are connected by a common transmission line.

ABSTRACT OF THE DISCLOSURE

The present invention is provided with one main station and a plurality of substations. After transmitting data addressed to all substations, the main station transmits a message addressed to all substations to query whether reception was normal. When unable to receive data normally, the substations transmit a response message to the query message, but do not transmit a response message when data reception was normal. The time for confirming that transmission was normal or abnormal can be shortened by the main station transmitting data addressed to all substations only one time, and by the substations transmitting response messages only in the case of abnormal reception.

FIG. 1

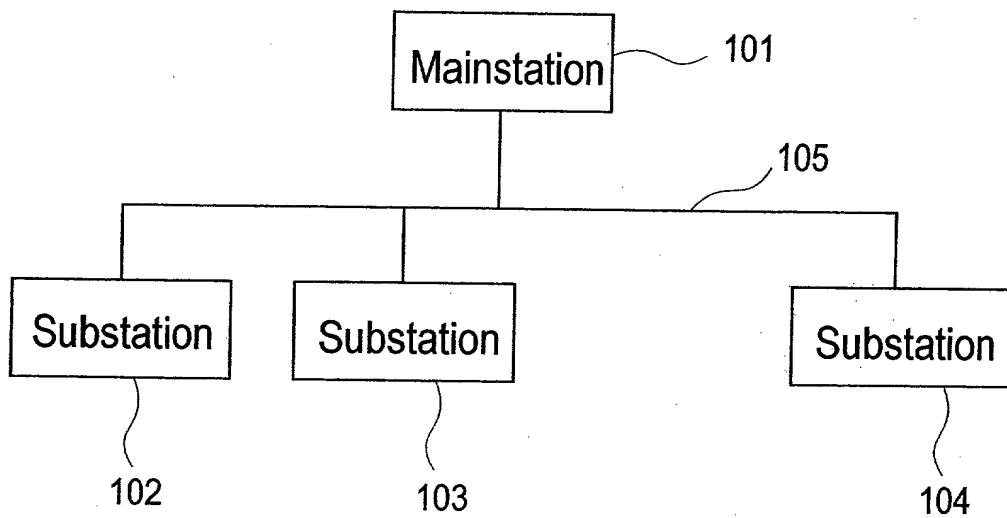


FIG.2

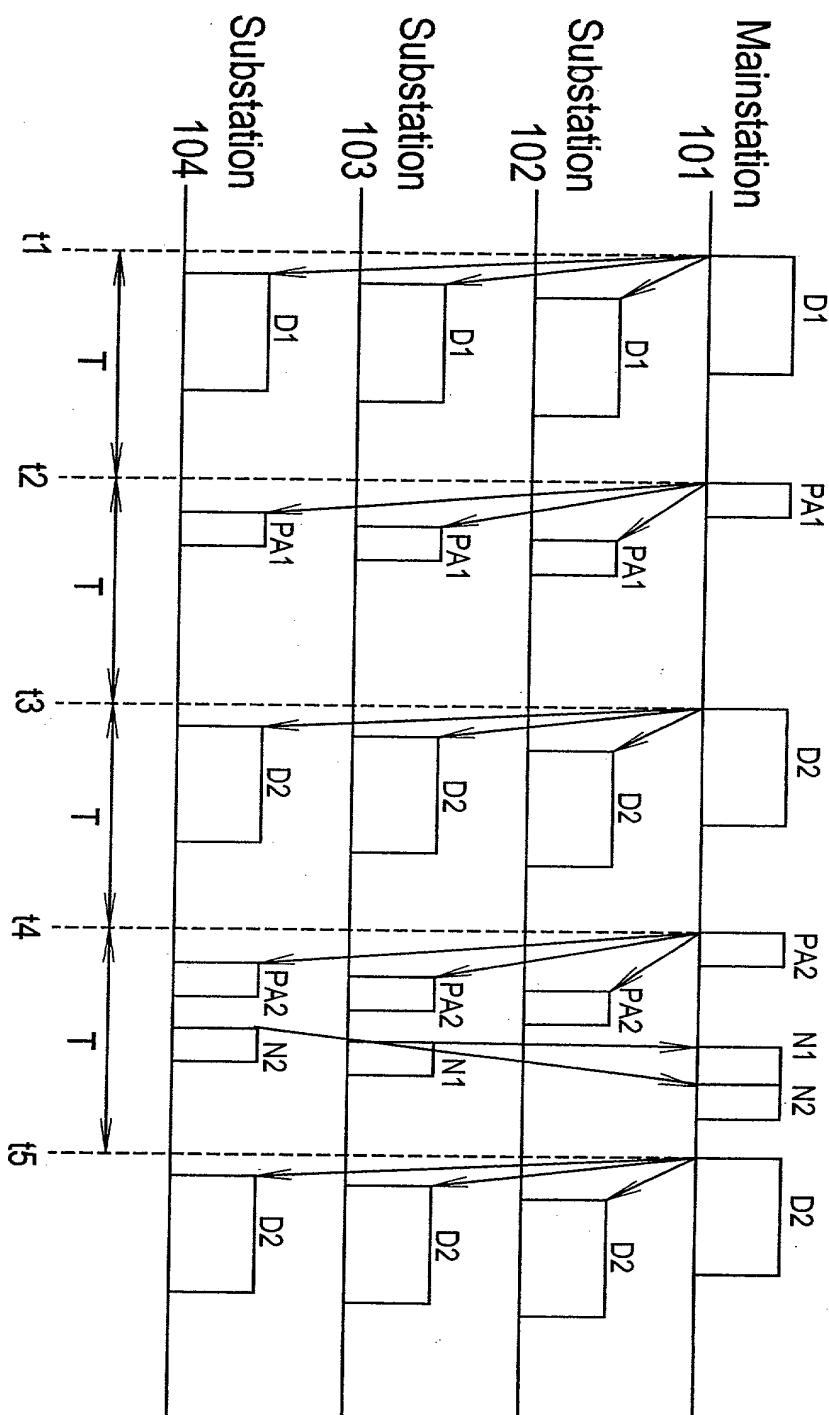
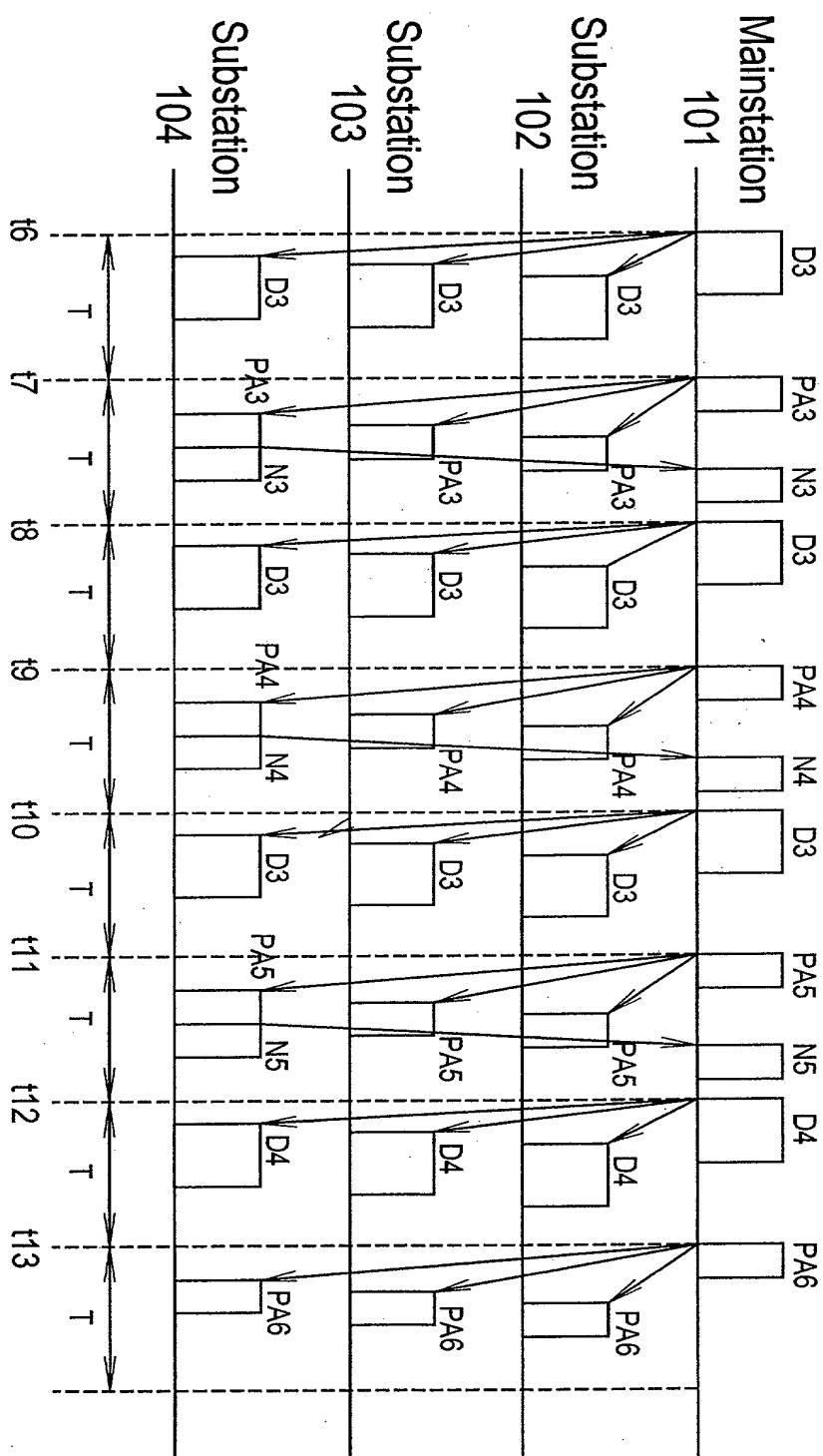


FIG. 3



DECLARATION FOR UNITED STATES PATENT APPLICATION,
POWER OF ATTORNEY, DESIGNATION OF CORRESPONDENCE ADDRESS

Attorney Docket

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and that I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled Data Communication System

the specification of which
[X] is attached hereto.

[] was filed on _____ as Application No. _____
and was amended on _____ [if applicable].

[] was filed under the Patent Cooperation Treaty on _____
Serial No. _____, the United States of America being designated.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, '1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, '119 of any foreign application(s) for patent, utility model, design or inventor's certificate listed below and have also identified below any foreign application(s) for patent, utility model, design or inventor's certificate having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s) Priority Claimed

Number	Country	Date Filed	Yes	No
181098/1999	Japan	June 28, 1999	X	

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: George H. Spencer (Reg. No. 18,038), Norman M. Kunitz (Reg. No. 20,586), Robert J. Frank (Reg. No. 19,112), Gabor J. Kelemen (Reg. No. 21,016), Robert Kinberg (Reg. No. 26,924), John W. Schneller (Reg. No. 26,031), Ashley J. Wells (Reg. No. 23,847), Allen Wood (Reg. No. 28,134) Suite 300 East, 1100 New York Avenue, N.W., Washington, D.C. 20005-3955, Telephone: (202) 414-4000, Telefax: (202) 414-4040. Address all correspondence to VENABLE, Suite 300 East, 1100 New York Ave., N.W., Washington, D.C. 20005-3955.

The undersigned hereby authorizes the U.S. attorneys named herein to accept and follow instructions from the undersigned's assignee, if any, and/or, if the undersigned is not a resident of the United States, the undersigned's domestic attorney, patent attorney or patent agent, as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and the undersigned. In the event of a change in the person(s) from whom instructions may be taken, the U.S. attorneys named herein will be so notified by the undersigned.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under '1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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